FASTRANS: National Food and Agriculture Sector Transportation and Movement Model

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USC VITERBI SCHOOL OF ENGINEERING

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UNIVERSITY OF MINNESOTA

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Outline

- Why FASTRANS?
  - Need for a national FAS transportation model
  - Consequence Modeling
- Project Overview
  - Research Questions
  - Project objectives
  - Project status

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Need for an Interstate FAS Transportation and Movement Model

- The FAS commodity transportation and movement infrastructure is not well documented
- Disease and contamination spread models can’t be employed to their full potential without such information

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The FAS Transportation/Movement Infrastructure is a Complex System

- The FAS infrastructure is an interlinked network of systems with multiple critical nodes
  - Large number of businesses/operations
  - Thousands of commodities
  - Each system/node exhibits unique vulnerabilities to attack
- The FAS infrastructure is ***dynamic*** and is influenced by many factors
  - Transportation network
  - Environment
  - Markets
  - International/global issues

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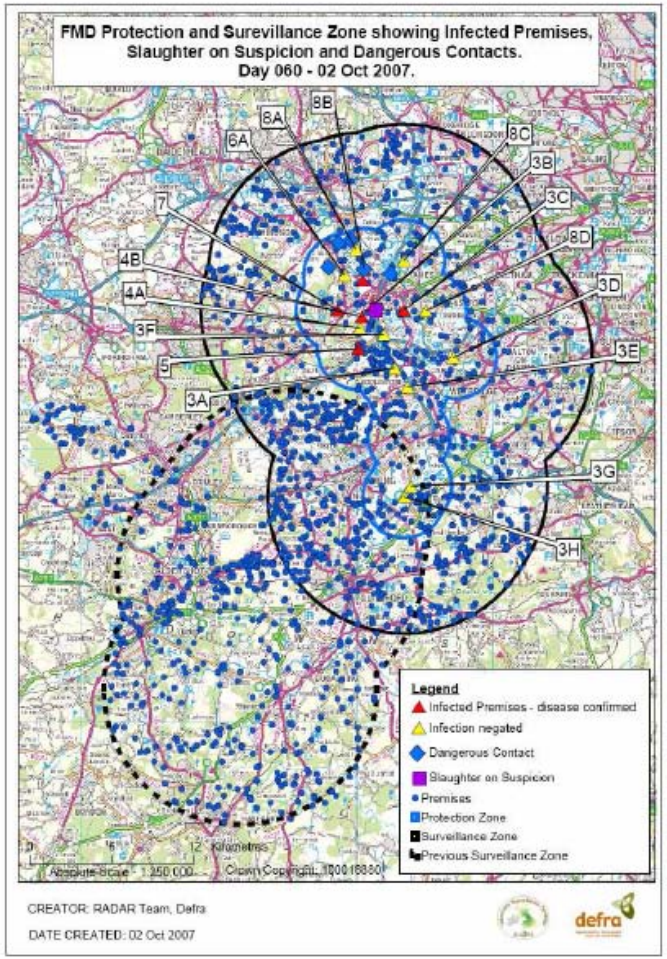
Disease Models Need Accurate Movement Data

- In many cases, the spread of diseases will follow the movement of commodities – which is *dynamic*
- Control strategies depend on the movement of commodities (e.g., get feed to infected cattle, etc.,)
- Current movement information stored in disease models is a snapshot of history



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Example: Cattle Movement

Some of the **factors** behind the movement of cattle

- Type of cattle (beef, dairy, breeders, show cattle, etc.)
- Weight/age
- Market conditions (price/1b, price of feed, price of fuel, etc.)
- Environment (seasons, droughts, etc.)
- Transportation (grid availability, trucking companies, etc.)
- Special circumstances
  - Disease outbreaks and quarantines

The US cattle industry is horizontal in structure

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What is the Research Question?

- How to accurately model the interstate movement of commodities without exposing sensitive data
  - Business sensitive: Data (premises, business rules/decisions, etc.)
  - Homeland Security: In some cases, data exposes vulnerabilities of the infrastructure to attack
- How to represent movement and business rules
  - Potentially large number of movement and business rules
  - A data management problem
  - Modeling movement at the approx. county level (many epidemic models operate at this level)
    - Example:
      - Approximately 3400 counties in CONUS
      - Assume 30 different animal types (e.g., breed, age, weight, etc.,)
      - 3400 x 3400 x 30 = 3.4M possible movement rules

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Objective – Long Term

- Development and deployment of an interstate FAS transportation and movement model (FASTRANS)
  - Provide decision support to decision/policy-makers in response to real-time outbreaks for strategic planning
  - Linked to existing epidemic, economic, and environmental models
  - Support new models that come on line
- Development and deployment of a FASTRANS Transportation Data Management System
  - Populated with captured transportation and movement data
  - Templates to allow local, state, regional, and national level users to enter information
  - Provides data to the interstate FAS transportation model
  - Data available for analysis and additional model development

Provide "insight" into the FAS movement infrastructure

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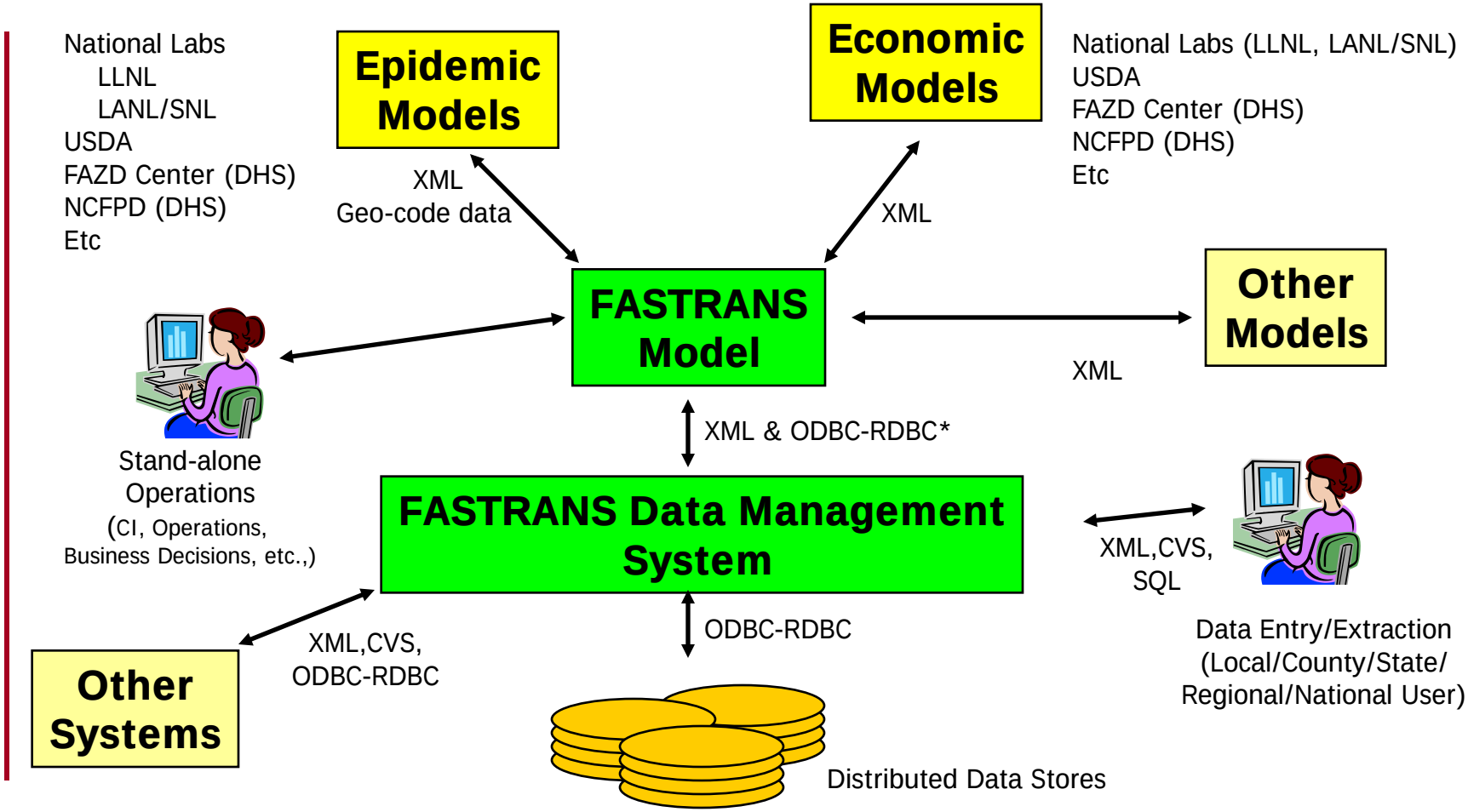
FASTRANS



* Both XML and ODBC-RDBC supported: allows model to interface to systems other than the FASTRANS data mgmt system

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Objective – Cattle/Swine FASTRANS

Development and deployment of an interstate cattle (beef and dairy) and swine transportation and movement model

- Largest gaps in knowledge exist in this sector
- Focus on providing movement data to enhance the epidemic and economic models for exotic disease
  - FMD modeling (DADS, MESA, NAADSM)
  - RVF modeling (FAZD/RVF)

Foot-and-Mouth Disease

Rift Valley Fever

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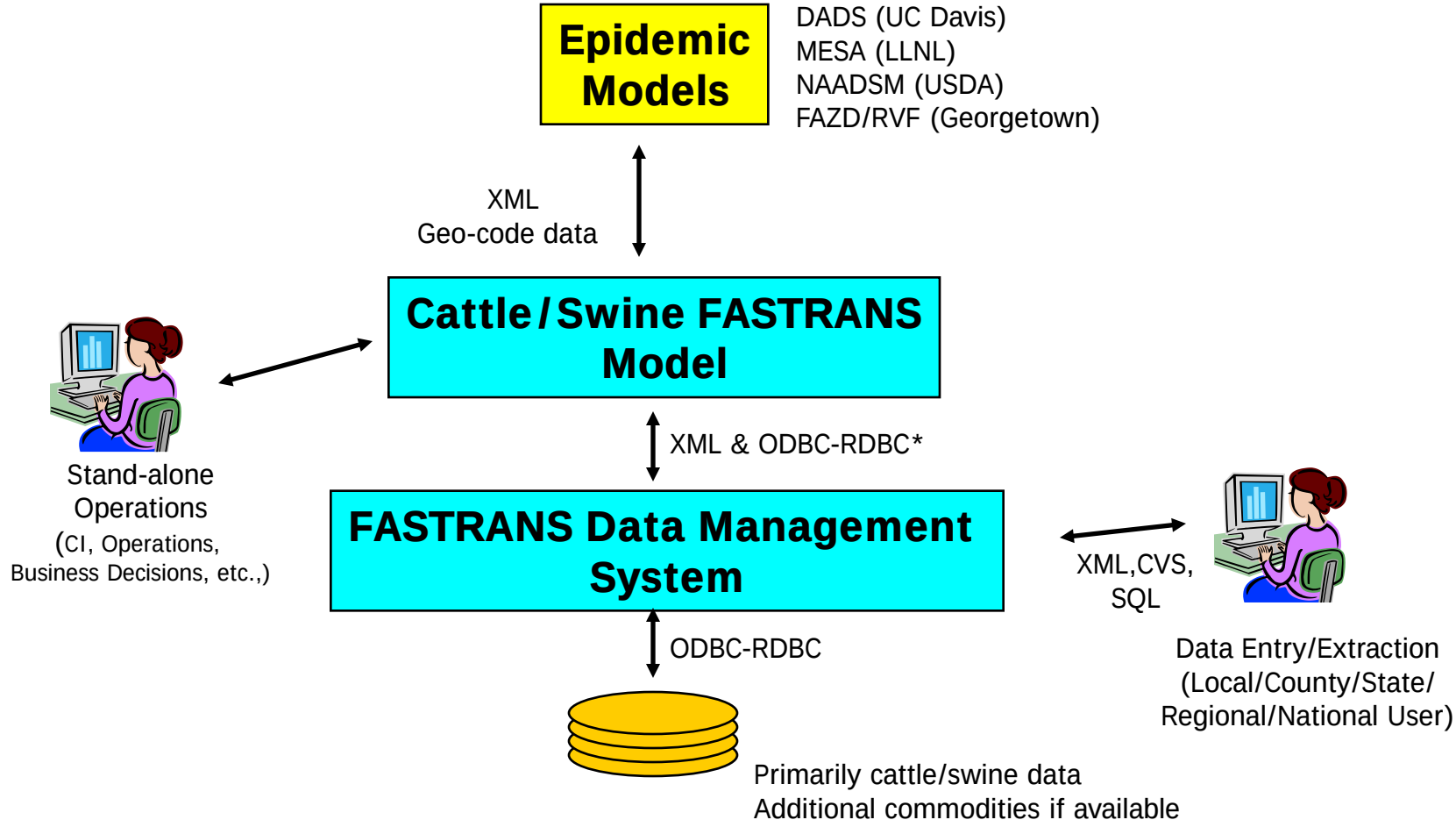
Cattle/Swine FASTRANS



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Current Status

- Prototype FASTRANS data management system operational
  - Populated with a small subset of cattle and swine movement data for CA, TX, NC, MN, IA
  - Server located at FAZD Center (Texas A&M University)
- Collected movement data from government agencies and the private sector
- Undertook pilot studies
  - Explored what impact the accurate representation of salesyards and truck stops has on FMD spread

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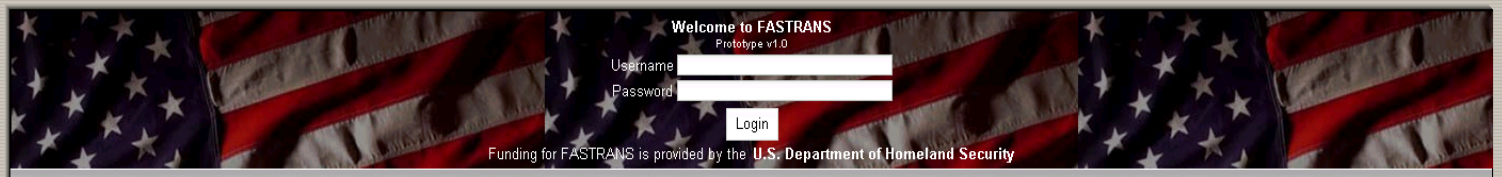
FASTRANS Software



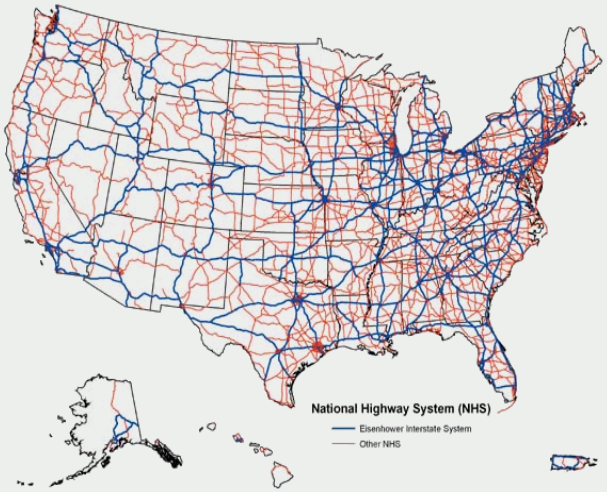
What is FASTRANS? **Partners** **People**

A critical component in the modeling of disease spread and mitigation strategies in the U.S. Food and Agriculture System (FAS) is the modeling of the interstate movement of animals and commodities. The FAS is composed of an interlinked network of systems with multiple critical nodes, each possessing unique vulnerabilities and potential consequences if attacked. In addition, the U.S. agriculture system is further complicated by the vast transportation network that interconnects these various systems and their subcomponents.

The national FAS transportation and movement model and data management system (FASTRANS) forecasts commodity movements based on existing business practices, environmental factors, and market conditions. FASTRANS is being developed to support the following applications:

- Provide up-to-date movement and marketing information to animal disease spread simulation models.
- Inform local, state, and national decision-makers on the prevention, intervention, and recovery from animal disease-based events.

The initial effort focuses on the interstate movement of live beef and dairy cattle and swine.



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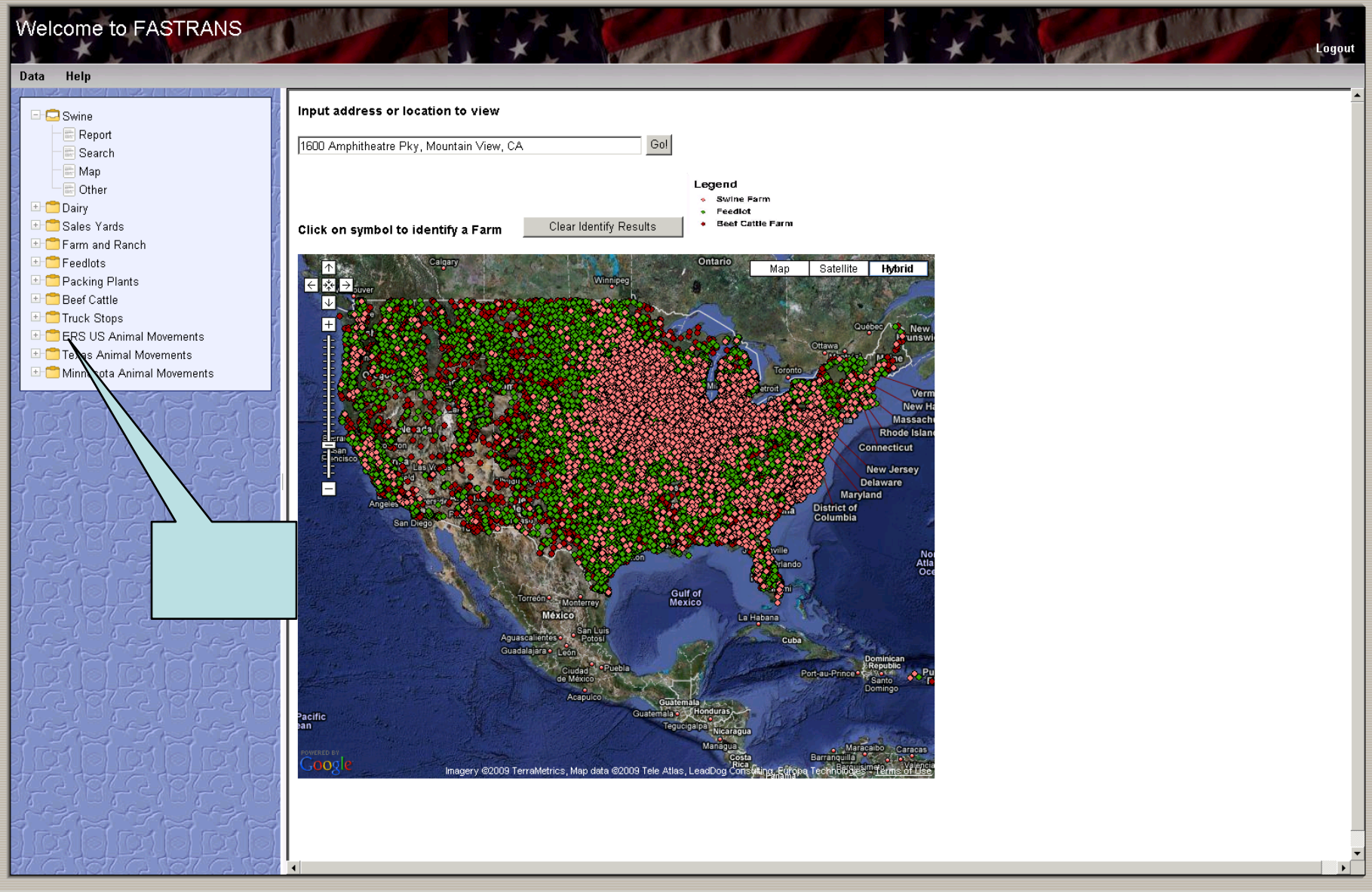
FASTRANS Software



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FASTRANS Software

Welcome to FASTRANS

Logout

Data Help

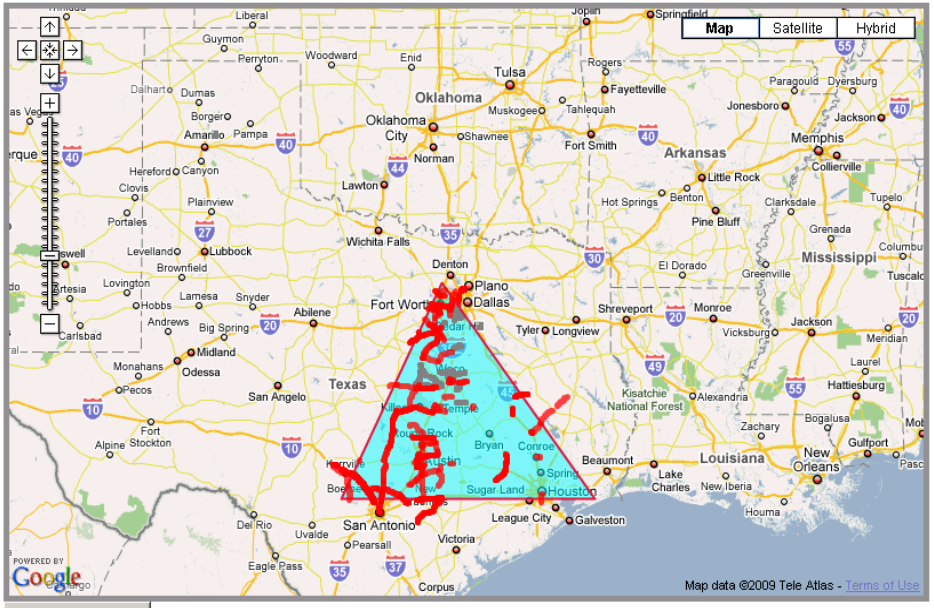
- Swine
  - Report
  - Search
  - Map
  - Other
- Dairy
- Sales Yards
- Farm and Ranch
- Feedlots
- Packing Plants
- Beef Cattle
- Truck Stops
- ERS US Animal Movements
- Texas Animal Movements
  - Report
  - Map
- Minnesota Animal Movements
  - Report
  - Map

Calculates the Head of Cattle Moved Per Year from Texas within a hand-drawn Quarantined Zone.

- Step 1: Click [Draw Quarantined Zone] and then click on the map to start drawing.
- Step 2: Double-click to stop drawing and fetch the population summary.
- Step 3: Click [Edit Quarantine Zone Polygon] to edit polygon. Application will automatically fetch new population summary.
- Step 4: Toggle Block Group polygons. These automatically redraw when polygon is edited.
- Click the Draw Polygon button again to start drawing a new polygon.

Total Area (mi^2): 34792.068682799996
Total Head of Cattle Moved Per Year: 36625
☑ **Toggle hand drawn Quarantine Zone**

1600 Amphitheatre Pky, Mountain View, CA [Go!]



[Clear Graphics] Latitude: 34.45221847 Longitude: -100.70068359

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  - Map
- Minnesota Animal Movements
  - Report
  - Map

columns filters sorts math preferences

DHS: FASTRANS Swine Farms [Add new record]

Displaying 7759 of 7759 possible records

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Next Steps

- Continue collection of cattle and swine movement/business data
  - Continue to refine movement/business rules in FASTRANS
- Expand to include other commodities
  - Livestock
  - Commodities
- Expand model to link to other models/systems
- Develop methods to assess vulnerabilities in the FAS infrastructure

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Thank You